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Victor Coffin

Plaintiff

v.

Ametek Inc., et al

Defendants

REPORT OF JOHN F. McCARTHY, SC.D., C.I.H.

I, John F. McCarthy, declare as follows:

1. I am President of Environmental Health & Engineering, Inc. ("EH&E"), with more than thirty years of experience in environmental exposure assessment. My particular focus has been on multimedia (air, water, soil) source characterization and assessment that could result in human exposure to contaminants in community, industrial and non-industrial settings. My work has involved the assessment and characterization of exposures to particles and gases, including respirable particulate matter and volatile organic compounds, among others. I have been employed by EH&E since January of 1988. Prior to that, from 1978 to 1988, I was employed as a research scientist by the Massachusetts Institute of Technology Energy Laboratory where I studied particulate and vapor production from various high temperature processes and evaluated health impacts of resulting airborne contaminants. My work has involved design and implementation of field and controlled chamber studies to determine the source, transport, and fate of various airborne contaminants, as well as evaluating their possible exposure potential and risk.

2. I am certified by the American Board of Industrial Hygiene in Comprehensive Practice. I received my Master of Science degree in Environmental Health Sciences, specializing in Air Pollution Control and Industrial Hygiene, from Harvard University in 1978. I received my Doctor of Science degree in Environmental Science and Physiology, specializing in Physical Science and Engineering, from Harvard University in 1987. I have published numerous scientific papers on air quality analysis, including exposure characterization in indoor environments, as well and served as the Program Director for a number of research projects for the U.S. Environmental Protection Agency's (EPA) Indoor Environmental Quality Division and the National Institute of Occupational Safety and Health's Division of Respiratory Disease Studies. I have served on several private, governmental and professional organizations' health and safety committees. I was the Principal Investigator on the research studies related to problem drywall conducted by EH&E, on behalf of the Consumer Product Safety Commission. My qualifications and experience are further detailed in my curriculum vitae, which is attached hereto as Appendix A.

3. I have been asked to review a number of documents relevant to the potential for occupational exposure to asbestos fibers in the air while Mr. Coffin worked as a Bridge Operator for the Maine Central Railroad Company (MCR) and the Maine Department of Transportation (MDOT) at the Carlton Bridge, situated in Bath, Maine. I have also reviewed various articles and reports in the general literature, and documents specifically related to Mr. Coffin, and have been asked to render an opinion as to whether Maine Central Railroad:

- a) Contributed to an unsafe environment for him during his normal course of activities, that he stated he undertook and experienced as a Bridge Operator.
- b) Contributed to potential levels of asbestos-containing particles, in the areas in which he was present, that were considered excessive and the potential hazards were foreseeable.

4. I reviewed a variety of relevant case materials including:

- The Complaint filed November 15, 2018
- Deposition of Mr. Victor Coffin, dated September 17 and 18, 2018
- Report by Northeast Test Consultants titled Professional Review for Asbestos Exposure relating to Victor A. Coffin v. State of Maine/Dept of Transportation, dated August 17, 2018.
- Transcript of Stephen Broadhead at Worker's Compensation Hearing, November 27, 2018.
- URS Corporation's Asbestos & Lead-Based Paint Compliance Audit Report from March 2005 for Brunswick Post Office.
- Cardno ATC's Limited Asbestos-Containing Material and Lead Containing Paint Inspection Report from July 2013, for Brunswick Post Office.
- Additional documents are detailed in Appendix B

BACKGROUND

5. Mr. Victor Coffin was born on November 26, 1948 in Bath, Maine.¹ He graduated from Brunswick High School in 1967.² He has four children: Victor, Nathan, Jonathan and Ryan.³ He was diagnosed with Mesothelioma on January 18, 2017.⁴

¹ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 11, 20-21

² Deposition of Victor Coffin, Volume 1, September 17, 2018, page 41-42, 70-71; Exhibit 2

³ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 12

⁴ Complaint filed November 15, 2018; Victor Coffin v. Ametek, Inc., et al.

Relevant Chronology of Mr. Victor Coffin's Work History

- Summer 1967-December 1967 Maine Central Railroad (Assistant Drawbridge Operator on the Carlton Bridge for approximately six months)⁵
- 1968-1971 Navy (Aircraft electrician)⁶
- 1971-1987 Main Central Railroad (MCR) (Worked where boxcars were rebuilt and maintained for about a month with remaining time spent as Drawbridge Operator on Carlton Bridge)⁷
- 1987-1988 Maine Department of Transportation (Chief Operator of Carlton Bridge for a 10-month timeframe)⁸
- 1988-2012 U.S. Postal Service (Rural letter carrier)⁹

6. Additionally, Mr. Coffin reported potential dust exposure scenarios during various activities that he would undertake, including home improvement at the family home while growing up, during personally building his own home, home automotive work, and work as a Masonry Tender for supplemental income.

United States Navy

7. After a 12-14 week boot camp in 1968, Mr. Coffin was sent to Jacksonville, Florida for aircraft electrician training for six months; training involved 90 percent classroom instruction and 10 percent hands-on work on obsolete Korean war aircraft, working on such things as fuel gauges and lights.¹⁰ After finishing training, he was sent to his permanent duty station in Cecil Field, Florida until he went to Vietnam in 1970.¹¹ He received classroom training on the Navy A-1 Corsair during this time involving navigation system components and terrain guidance system components among other general training; he was an aircraft electrician during this time.¹² As an aircraft electrician, he was responsible for maintaining a squadron of Corsairs, about 20; he worked on all the electrical components except for the basic radio and radar, including all the external lights and all of the gauges and switches, such as landing gear switches.¹³ He also reported that he may have worked with aircraft components containing gaskets such as during replacement of sensors on engines.¹⁴

⁵ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 41-42, 70-71; Exhibit 2

⁶ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 124-132

⁷ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 77-78

⁸ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 160

⁹ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 160-161

¹⁰ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 124-127

¹¹ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 128, 134

¹² Deposition of Victor Coffin, Volume 1, September 17, 2018, page 129-132

¹³ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 135-136

¹⁴ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 138-139

8. While in the U.S. Navy, he was also assigned to a temporary additional duty at a Marine Corps air station in Yuma, Arizona for about seven months after Cecil Field; his duties stayed the same and continued to involve performing maintenance on Corsairs.¹⁵ He went back to Cecil Field after Arizona, since it was a temporary assignment, and was then stationed at an army base in Eustis, Virginia for about a month to get training on the electrical systems on helicopters.¹⁶ On August 31, 1970, he was sent to Vietnam to work at a helicopter base as an aircraft electrician.¹⁷

9. At the helicopter base in Vietnam, there were about 20 Bell Huey helicopters he would work on.¹⁸ He worked on various electrical components such as the compass, all the lighting, and all the wiring within the helicopter.¹⁹ The only time he felt he would have worked on anything containing asbestos during this time would be when he would have had to help mechanics change an engine which contained gaskets; he did not report how often he would have done this.²⁰ He characterized this as minimal involvement work which required helping lift up engines for replacement, he was not involved in taking apart engines.²¹ Mr. Coffin reported that when he was in Vietnam and working on the Hueys, electricians would be working alongside mechanics and there could be multiple different categories of maintenance people working at the same time on the helicopters.²²

10. Mr. Coffin recalled an asbestos shield being present in the crew compartment between where they sat and the engine – the fuel tank was directly behind them, “there was an entire wall of -- it looked like a silver quilt, and it was asbestos, and it just kept the crew component away from fuel if that ever happened”.²³ “This shield was to keep the fire, if there was a crash, away from the pilot; he was told this was asbestos”.²⁴ “The shield was about 8-9 feet wide, 5 feet high, a quarter to half inch thick and was attached to the back wall of the helicopter”.²⁵ “There was diamond stitching running through this silvery fabric”.²⁶ He recalled that some of the shields had bullet holes and shrapnel holes.²⁷

11. He also recalled a mitt/asbestos pads that were used by pilots to remove the hot gun barrel from the helicopters– although he did not use these, he reported having to move these “asbestos pads” once in a while if they had to get to something.²⁸ He never wore a respirator during

¹⁵ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 145

¹⁶ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 146, 149

¹⁷ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 128, 134, 146

¹⁸ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 147

¹⁹ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 149-150

²⁰ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 150

²¹ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 435

²² Deposition of Victor Coffin, Volume 2, September 18, 2018, page 517-518

²³ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 150-151, 153

²⁴ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 153

²⁵ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 428-429

²⁶ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 429

²⁷ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 430

²⁸ Deposition of Victor Coffin, Volumes 1 & 2, September 17 and 18, 2018, page 151, 153, 432

any of his aircraft work.²⁹ He recalled that he had an accident while working, which required surgery on his spine, in which he was hospitalized for 30 days while in Vietnam after which he went back to his regular duties.³⁰

Maine Central Railroad (MCR) Summer of 1967–December 1967, and 1971–September 1987

12. Mr. Coffin started working at MCR in the Summer of 1967 and worked for about six months until December 1967 before joining the Navy; he worked as an Assistant Drawbridge Operator in the Signal Department and was assigned to work on the Carlton Bridge, located between Bath and Woolwich, Maine; he worked 11 a.m. to 7 p.m.³¹ His job involved routine maintenance and operation of the bridge, which included, greasing, maintenance of the equipment, and cleaning.³² Generally speaking, the majority of his time spent in the control room during this timeframe was watching ship traffic and raising and lowering the bridge.³³

13. When he returned from the Navy, Mr. Coffin went back to work at MCR; he first went to work at a place called the Waterville Shops in Waterville, Maine for four to six weeks doing electrical work in the facility such as in offices and buildings; this was a big repair and maintenance facility for train cars/boxcars with asbestos containing brakes— there would be multiple boxcars under maintenance in the shop.³⁴ His tasks at the Waterville shops involved installing fluorescent lighting in different section houses, he also did work in the shop where the railroad boxcars would be repaired— he ran conduit and installed wiring for a coke machine in the breakroom, and also climbed poles and replaced outside lighting.³⁵ There were different crews working on the different components of the boxcars, and Mr. Coffin reported that dust would be generated during repairs inside the main part of the boxcars.³⁶ He recalled the shop being dusty and dirty and assumes this dust contained asbestos.³⁷ Although he did not have a specific recollection of having observed anyone working on brakes on the boxcars when he was doing his tasks in the shop, he reported that the boxcars would have required brake work and maintenance for wear.³⁸ He also recalled seeing air hoses being used in the shop on the undercarriage of the box cars, which were the wheels.³⁹ He spent two days in this shop installing conduits while such work was going on.⁴⁰ Regarding the location of the shop, he reported that the shop was just through a

²⁹ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 155

³⁰ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 156-157

³¹ Deposition of Victor Coffin, Volumes 1 & 2, September 17 and 18, 2018, page 70-72, 77, 335

³² Deposition of Victor Coffin, Volume 1, September 17, 2018, page 84-87, 91-100, 107, 283

³³ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 299

³⁴ Deposition of Victor Coffin, Volumes 1 & 2, September 17 and 18, 2018, page 77-78, 276

³⁵ Deposition of Victor Coffin, Volumes 1 & 2, September 17 and 18, 2018, page 79-80, 262

³⁶ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 518-519

³⁷ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 267, 274-275

³⁸ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 266-267

³⁹ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 267-269

⁴⁰ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 269-270

door into where he worked and that there might have been a short hallway leading directly into the shop; his boss's work area was attached to the building with the shop and he reported, "I was in and out of that building all the time".⁴¹

14. After being at the Waterville Shops, Mr. Coffin returned to the Carlton Bridge and worked at this bridge until 1987.⁴² There would also be times in the wintertime, where he would get laid off periodically and he would go to work at the Rigby yard and the main yard in South Portland, Maine to do snow removal.⁴³ He reported working swing time for "quite some time" and worked 1 p.m. to 9 p.m. on Mondays and Tuesdays, 9 p.m. to 5 a.m. on Wednesdays, he would get Thursday and Friday off and then on Saturdays and Sundays worked 5 a.m. to 1 p.m.⁴⁴ His duties were not any different during these shifts except that he did not do maintenance tasks on the 9 p.m. to 5 a.m. shift, unless it was required.⁴⁵ He worked an eight-hour overtime shift every two weeks, but otherwise worked 40-hour weeks.⁴⁶

15. Working as an operator of the bridge, Mr. Coffin spent 90 percent of his time in the control/operating room.⁴⁷ He estimated spending an average of once a week in the engine room but did not specify how long he would be in there. While in the control room, he would be watching for boats, and listening to radio traffic of boats coming and going to operate the drawbridge accordingly.⁴⁸ On a typical day as a Drawbridge Operator, he monitored traffic (unless there was maintenance scheduled).⁴⁹ He recalled that most of the maintenance work entailed greasing components.⁵⁰ Besides monitoring the traffic of cars, trains and ships coming down the river. Mr. Coffin described his other regular duties and responsibilities as Drawbridge Operator: greasing components as part of regularly scheduled maintenance, maintaining/replacing navigational lights, stair lights and catwalk lights, maintaining about 80 back-up batteries by periodically adding acid, and general cleaning every couple of weeks.⁵¹

16. Mr. Coffin testified having assisted his boss in replacing the worn brakes associated with the lift mechanisms on the bridge on two occasions (once in the 1970s and once in the 1980s), as part of an unscheduled maintenance. It took two hours to remove the brakes, replace the pads and put the brakes together.⁵² He described how they changed the brakes: they would loosen the shoes off and the braking material was on the inside; replacement braking material was inside the

⁴¹ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 269

⁴² Deposition of Victor Coffin, Volume 1, September 17, 2018, page 79-80

⁴³ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 80-81

⁴⁴ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 83

⁴⁵ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 84

⁴⁶ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 90

⁴⁷ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 344-345

⁴⁸ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 86-87

⁴⁹ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 89

⁵⁰ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 90

⁵¹ Deposition of Victor Coffin, Volumes 1 & 2, September 17 and 18, 2018, page 84-87, 90-100, 368-369

⁵² Deposition of Victor Coffin, Volume 1, September 17, 2018, page 112

maintenance shop— they would take the shoes to the maintenance shop, put them in a vise, they were held by 10-12 rivets, they would drill those out, pull out the leftover padding, they would cut out the padding material with a hacksaw, cut it to fit, drill it and put rivets and peen them over and put it back together— the replacement braking material was tannish gray and was stored as a roll of 10 feet material.⁵³ He did not know the brand of friction material they used for this work.⁵⁴ He estimated the dimension of each brake shoe to be four inches wide and 16-18 inches long.⁵⁵ The breaking system was inside the engine room.⁵⁶ When they removed the brake, he reported there was dust from use; the room where the motor was located was described as dusty and greasy.⁵⁷ He also recalled that since they had to rivet the lining back on the brake shoes, there would be dust generated during drilling with a hammer.⁵⁸

17. Mr. Coffin also reported having replaced the brake material on the braking system of the barrier gate about four times by himself during his entire tenure.⁵⁹ There was one brake per barrier gate and two gates on each end of the bridge; there were two linings per brake.⁶⁰ He recalled doing this much the same way— with the same friction material that he cut with a hacksaw as that of the brakes for the motors, except that these were much smaller brakes— three by five inches.⁶¹ It took him an hour and a half to two hours to change a brake on the barrier gates, it took seconds to cut the new friction material and four to five minutes to remove the old friction material; 30-45 minutes to install the new friction material since he would have to re-rivet it by hand onto the shoe.⁶²

Maine Department of Transportation (MDOT) September 1987–July 1988

18. Mr. Coffin remained a Drawbridge Operator for MCR until September 1987 when the Maine DOT took over and gave him the Chief Bridge Operator title; he was employed by the DOT for approximately 10-months after which he retired from the railroad.⁶³ As a Chief Bridge Operator, he also had administrative duties like keeping time sheets and training new people, in addition to his typical duties he would have done as a Drawbridge Operator.⁶⁴

⁵³ Deposition of Victor Coffin, Volumes 1 & 2, September 17 and 18, 2018, page 114, 366-367

⁵⁴ Deposition of Victor Coffin, Volumes 1 & 2, September 17 and 18, 2018, page 114

⁵⁵ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 361

⁵⁶ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 362

⁵⁷ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 368

⁵⁸ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 369

⁵⁹ Deposition of Victor Coffin, Volumes 1 & 2, September 17 and 18, 2018, page 117, 288

⁶⁰ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 292-293

⁶¹ Deposition of Victor Coffin, Volumes 1 & 2, September 17 and 18, 2018, 117-119, 291, 371

⁶² Deposition of Victor Coffin, Volume 2, September 18, 2018, page 291-292

⁶³ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 82, 160

⁶⁴ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 82-83

The Carlton Bridge

19. The Carlton bridge opened for train traffic—lower deck in October 1927 and officially opened to automobile traffic—upper deck on November 15, 1927.⁶⁵ The control/operating room, where Mr. Coffin operated the draw itself to raise and lower the bridge, was a two-story room located on the tower above the street and went all the way across the bridge from side to side.⁶⁶ From the ground floor to the top, the control room was about 20 feet high; on the bottom section of the control/operating room was where the span locks were located to lift the bridge.⁶⁷ The backup batteries and the maintenance/machine shop was located on the top story where there were tools, vices and grinding wheels; the maintenance shop was the same dimension as the operating room, about 10 by 20 ft with 10 ft ceiling; the windows in the maintenance shop were never opened but they always kept the door open; he reported that there was no ventilation in the maintenance shop.⁶⁸

20. Mr. Coffin reported having done a lot of work in the maintenance/machine shop, including maintenance work on the contact knife blades inside the rail locks, which involved removing them and using the grinding wheel with a wire brush on one end to clean the contacts once every couple of weeks.⁶⁹ There were also contacts from an electrical panel in the control room that he would have to remove and smooth out the surfaces with the grinding wheel and reinstall.⁷⁰ He reported that he did not think the grinding wheels contained asbestos.⁷¹

21. Beneath the middle of the span or beneath the roadway is the engine room where the motors were located to lift and lower the bridge.⁷² The breaking system was also inside the engine room.⁷³ Mr. Coffin recalled the engines were electric and were approximately four feet long, three feet high and provided the power to turn the shaft to turn the spool that pulls the cables down, which would lift the bridge up and also lower the bridge back down; the brakes for the engines were separate from the motors.⁷⁴ Mr. Coffin believes there was asbestos on the exposed brakes for the electric motors, since it required a very large braking system—the span weighed 270 tons; when the brakes were used, it would slow down the bridge and produce dust from stopping, due to wear and friction.⁷⁵ He explained the braking mechanism: there was a drum and two brakes

⁶⁵ <https://www.mainememory.net/artifact/27897>

⁶⁶ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 101

⁶⁷ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 106

⁶⁸ Deposition of Victor Coffin, Volumes 1 & 2, September 17 and 18, 2018, page 106, 280-282

⁶⁹ Deposition of Victor Coffin, Volumes 1 & 2, September 17 and 18, 2018, page 107, 283

⁷⁰ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 284-285

⁷¹ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 341

⁷² Deposition of Victor Coffin, Volume 1, September 17, 2018, page 108-109

⁷³ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 362

⁷⁴ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 110

⁷⁵ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 13-14

wrapped around the drum, one on each side; when he would apply the brakes, it would press on the drum and slow the motor down which would then slow the bridge down, producing dust.⁷⁶

Use of Asbestos-Containing Material (ACM) on the Carlton Bridge

22. Mr. Coffin testified that at some point after he left the bridge in 1988, he had heard about asbestos remediation that took place in 2001 at the Carlton Bridge related to the engine room, control room, and the machine shop.⁷⁷ He recalled that there was also an outhouse down on the tracks that was built using material similar to the control room.⁷⁸

23. According to bidding documents for asbestos abatement work at the Carlton Bridge in Bath, Maine, in 2001, the storage shed, control room, and machinery house had some asbestos containing materials (“ACM”). Based on Asbestos Disposal & Documentation forms provided from the MDOT remediation in 2001, friable and non-friable wrapped ACM was removed from the Carlton Bridge; however, these forms do not specify the location of each of those materials.⁷⁹

24. OSHA defined friability to mean “that the material can be crumbled with hand pressure and is therefore likely to emit fibers.”⁸⁰ They further clarify by providing examples to qualify that the “fibrous fluffy sprayed-on materials used for fireproofing, insulation, or sound proofing are considered to be friable, and they readily release airborne fibers if disturbed. Materials such as vinyl-asbestos floor tile or roofing felt are considered non-friable if intact and generally do not emit airborne fibers unless subjected to sanding, sawing and other aggressive operations. Asbestos-cement pipe or sheet can emit airborne fibers if the materials are cut or sawed, or if they are broken.” The United States EPA in its document entitled “Asbestos NESHAP Regulated Asbestos-Containing Materials Guidance” specifically categorizes cement siding, transite board shingles, etc. as nonfriable ACMs.⁸¹

25. Mr. Coffin described the construction of the control room as being made up of individual panels with a one-inch strip of trim covering each of the seams.⁸² This had been painted multiple times over the course of occupancy. This type of construction is consistent with the typical use of cement panels, even to this day, where control joints (sometimes referred to as expansion joints) are used to account for potential expansion under various weather conditions and possible

⁷⁶ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 14

⁷⁷ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 328-329, 504-505

⁷⁸ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 506

⁷⁹ Materials Produced in the Matter, WC Exhibit 6, 7 and 9-12 (03223292xAE394)

⁸⁰ OSHA 1926 Substance Technical Information for Asbestos - Non-Mandatory. Toxic and Hazardous Substances, Subpart Z, Safety and Health Regulations for Construction

⁸¹ Shafer, R., et al. 1990 Asbestos/NESHAP regulated asbestos-containing-materials guidance. No. PB-91-218701/XAB. Alliance Technologies Corp., Chapel Hill, NC (United States), 1990.

⁸² Deposition of Victor Coffin, Volume 2, September 18, 2018, page 356, 508-509

vibration and thereby avoid physical damage to the rigid panels. In the deposition testimony of Michael Brodhead he describes typical construction he has observed of transite sheet installation where “Typically the sheets of transite would be arranged vertically with a gap -- a -they call it an expansion gap or a vibration proof gap between the edges of each sheet, so that they didn’t rub together. And that was less of I think a concern about creating fiber dust; as more as a just creating a – an abrasion issue when these were originally installed. And then over the top of that gap was usually placed a – a cover section.”⁸³

26. Mr. Coffin related in his deposition that trains would be coming with loads of concrete from a cement plant– the Thomaston Cement Plant in Rockland, Maine and the bridge would shake as the train passed. Although the walls/panels would vibrate, Mr. Coffin did not observe any dust resulting from this movement, nor did he ever have to do any clean-up within the control room or other internal spaces, associated with this movement of the wall panels.⁸⁴ Therefore, it appears that the lack of dust being generated from the overall movement of the individual panels, as well as the lack of physical damage occurring to the individual panels and the maintenance of the physical integrity of the various rooms on the bridge, demonstrate that the control joints were effective in achieving their intended design purpose.

27. A health and safety inspection form prepared by the state of Maine on February 16, 1984 found very few items of concern on the Carlton Bridge.⁸⁵ Within the “Operator’s Room” they noted an electrical panel with exposed electrical connections. This memo did not note any damage or deterioration of the internal wall panels or mention the possibility of potential exposure to asbestos to occupants.

28. Mr. Coffin recalled being present in the 1980s during work involving replacement of a leaking lead pipe inside the walls of the maintenance room, associated with capturing roof water; a crew tore out a section of ceiling and wall to get to the pipe in order to replace it; the work took three to four hours and the material removed for the work was about two feet by four feet.⁸⁶ There was dust created during this work and Mr. Coffin reported having been present in the room during this work.⁸⁷ He did not recall having seen insulation material inside the wall when the work was getting done.⁸⁸ He reported having cleaned up after the work was done and recalled taking a brush and brushing the dust off the tops of the batteries and sweeping the floor; cleaning up took him about 20 minutes.⁸⁹

⁸³ Stephen Broadhead’s Hearing Transcript for the State of Maine Worker’s Compensation dated November 27, 2018, page 17.

⁸⁴ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 356, 508-509

⁸⁵ State of Maine Inter-Departmental Memorandum. 1984.Inspection of the Carlton Bridge – Bath/Woolwich. February 16, 1984.

⁸⁶ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 329-330, 507

⁸⁷ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 330-331

⁸⁸ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 375

⁸⁹ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 509-510

Proximity of Carlton Bridge to Bath Iron Works

29. Mr. Coffin noted that the Bath Iron Works (BIW) was located near the bridge, within a quarter of a mile, according to Mr. Coffin's approximation.⁹⁰ Mr. Coffin reported that during the summer months, the windows were all open in the control room and wind would generally come from the south and BIW was south of the Bridge.⁹¹ Mr. Coffin believes that he could have been exposed to the airborne asbestos fibers drifting from BIW when they worked in the hulls of ships.⁹² Naval ships often utilized the far more potent forms of amphibole asbestos, primarily amosite, extensively throughout their ships.

U.S. Postal Service Work 1988–2012

30. Mr. Coffin started working for the post office in 1988 as a rural letter carrier in Brunswick, Maine and worked until 2012, when he retired.⁹³ He reported having used his personal vehicles, which were Subaru's for this job until the last two years when he was provided with a postal vehicle.⁹⁴ He recalled having to change all four brakes; he did not report how often he did this.⁹⁵ It took him an hour to change the front brakes for a Subaru.⁹⁶

31. The presence of ACM has been confirmed for the Brunswick Post Office location in inspection/assessment documents prepared by URS Corporation and comprised of the following asbestos containing materials in the building: pipe fittings (20% chrysotile asbestos); floor tiles (5-10% chrysotile asbestos); floor tile mastic (3-8% chrysotile asbestos); ceiling tiles (10% amosite asbestos); floor tiles (30-40% amosite asbestos).⁹⁷ In addition, according to the Northeast Test Consultants report, three asbestos abatement actions were conducted at the Brunswick post office in 1998, 1999, and 2000 and included removal of amosite asbestos ceiling tiles and chrysotile asbestos mastic material.⁹⁸ Per Stephen Broadhead's report dated August 17, 2018, pertaining to ACM in the Brunswick Post office, the building during Mr. Coffin's employment period, contained both friable and non-friable asbestos materials, and non-friable materials that could be impacted into a friable state such as floor tiles by the use of abrasive floor buffing, foot traffic, and constant impact by such actions as rolling mail carts and dollies over the surfaces. In addition, Broadhead reported on the probability of asbestos fiber contamination from vibrating amosite

⁹⁰ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 318-319

⁹¹ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 319

⁹² Deposition of Victor Coffin, Volume 2, September 18, 2018, page 320

⁹³ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 160-161

⁹⁴ Deposition of Victor Coffin, Volumes 1 & 2, September 17 and 18, 2018, page 162, 447

⁹⁵ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 447

⁹⁶ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 458

⁹⁷ Report by Northeast Test Consultants titled Professional Review for Asbestos Exposure relating to Victor A. Coffin v. State of Maine/Dept of Transportation Dated August 17, 2018

⁹⁸ Report by Northeast Test Consultants titled Professional Review for Asbestos Exposure relating to Victor A. Coffin v. State of Maine/Dept of Transportation Dated August 17, 2018

containing ceiling tile systems that subsequently could have been deposited on surfaces and materials located within the mail processing areas of the building, that would then be handled by Mr. Coffin during his rural route delivery duties.⁹⁹

Home Remodeling Work

32. While growing up, Mr. Coffin recalled helping his father move walls around in their house and put in a bathroom sometime in the late 1950s using sheetrock and 2 x 4's.¹⁰⁰ His father would tear the walls down and he would carry them out.¹⁰¹ He recalled that he did not help with application of joint compound, which he recalled came as a dry product that had to be mixed.¹⁰² Although he did not help, he was near the joint compound being mixed; he recalled the presence of dust when it was poured.¹⁰³

33. The attached garage in their home was torn down and a separate two-car garage built when the plaintiff was around 8-10 years old in the late 1950s.¹⁰⁴ He helped his father by picking up the related construction debris; he recalled that his father removed the asbestos siding—white in color with gray interior, saved it and put it back on the new garage.¹⁰⁵ Other material he recalled during this renovation was wood and insulation; he did not know what type of insulation, except that it was “black crispy.”¹⁰⁶ His father had to use a cutter to cut the siding to reuse on the new garage; he recalled having helped during the teardown and rebuilding of the garage and recalled minimal dust generation during this process.¹⁰⁷ It took a couple days to take the shingles off from the old building, stack them up, his father tore down the structure, constructed a two car garage and then put the shingles back.¹⁰⁸

Work While Building Personal Residence

34. Mr. Coffin reported personally building his first home in 1975/1976 in Topsham Maine— it took six to eight months to build the house.¹⁰⁹ Besides hiring contractors to build the

⁹⁹ Report by Northeast Test Consultants titled Professional Review for Asbestos Exposure relating to Victor A. Coffin v. State of Maine/Dept of Transportation Dated August 17, 2018

¹⁰⁰ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 27-28

¹⁰¹ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 29, 33

¹⁰² Deposition of Victor Coffin, Volume 1, September 17, 2018, page 30

¹⁰³ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 31

¹⁰⁴ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 23-24

¹⁰⁵ Deposition of Victor Coffin, Volumes 1 & 2, September 17 and 18, 2018, page 24, 377-378

¹⁰⁶ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 25

¹⁰⁷ Deposition of Victor Coffin, Volumes 1 & 2, September 17 and 18, 2018, page 25-27, 380

¹⁰⁸ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 380

¹⁰⁹ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 175, 177, 216

foundation, install flooring—including Armstrong solarium inlaid vinyl flooring in the kitchen and sheet-rocking—Mr. Coffin did the remaining construction work, installed all the electrical, plumbing and heating system himself.¹¹⁰ He reported being in the house during installation of sheetrock.¹¹¹ The siding he used for the house was Masonite and wood; board and batting on the front with the rest being Masonite siding.¹¹² He installed using regular asphalt shingles for the roof.¹¹³ Mr. Coffin recalled installing a New Yorker Boiler and Beckett burner.¹¹⁴ He also reported having replaced a circulator pump four to five years later as well as a rope type gasket that came off around the door to the firebox which he also personally replaced.¹¹⁵ During the 17 years he lived at this house, he added bedrooms and finished the basement; he would hang the sheetrock and hire contractors to tape joints.¹¹⁶

Work as Masonry Tender for Supplemental Income

35. During the winter layoffs at Maine Central, for supplemental income, Mr. Coffin was a masonry tender for a friend of his who owned a business called Dale Wallace & Sons Concrete Masonry, this was on a part-time, sporadic basis for a period of six to eight years in the early to late 1980s.¹¹⁷ He stated that he worked with refractory cement which he reported contained asbestos.¹¹⁸ He estimated having worked with refractory cement a total of half a dozen times; it came either in powder form, that would have to be poured and mixed with liquid, or it came in a bucket like drywall mud.¹¹⁹

36. The type of masonry work he did involved foundations, fireplaces, chimneys, floors, for mostly residential clients (75 percent) and 25 percent commercial clients such as schools and businesses.¹²⁰ Mr. Coffin recalled one job in which they had to remove a large cast iron furnace with insulation “encased in white”, which he now believes was asbestos; they used a sledgehammer to break out the insulation which took them one to one and a half hours and then about two hours to carry it out and clean-up.¹²¹

¹¹⁰ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 175-178

¹¹¹ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 177

¹¹² Deposition of Victor Coffin, Volume 1, September 17, 2018, page 180

¹¹³ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 180-181

¹¹⁴ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 179, 228-231

¹¹⁵ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 217, 226-228, 238

¹¹⁶ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 181-182

¹¹⁷ Deposition of Victor Coffin, Volumes 1 & 2, September 17 and 18, 2018, page 163-164, 298-299

¹¹⁸ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 163, 169-173

¹¹⁹ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 170

¹²⁰ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 164-165

¹²¹ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 168

Home Automotive Work from 1964–2003

37. Around 1964, when Mr. Coffin was 15, he started working on cars, including his own and that of his parents and other family and friends.¹²² He reported having owned approximately 24 cars and that he would have done various work on these cars.¹²³ He has reportedly never owned a new car in his life; all the auto work would have been on used cars.¹²⁴ This auto work involved rebuilding transmissions and engines, changing oil, changing brakes and exhaust systems, clutch work and gasket related work.¹²⁵ He also recalled having rebuilt a 327 Chevy engine one time on his pickup truck around 1973 or 1974.¹²⁶

Brake Jobs

38. The plaintiff reported having changed brake pads, mostly on the front brakes.¹²⁷ He did brake work on both drum style and disc style and recalled Raybestos and Bendix brakes among others.¹²⁸ For each drum that he worked on, he would use an air hose to blow off dust, which only took a matter of seconds.¹²⁹ He reported that he never roughed up the padding with sandpaper.¹³⁰ All of the brake work he did was in driveways and garages.¹³¹

39. Mr. Coffin recalled the types of cars in which he had worked on brakes: '65 Mustang, '68 Dodge pickup, a bunch of Subaru's, '65 Chevy, '68 pickup truck, Volkswagen Beetle and Rabbit, '68 Chevelle, MGB, MG Midget, Ford Ranger.¹³² He did 8-10 brake jobs on his parents' car during the time he was 15 up until he left the house. He recalled another 8-10 total occasions he would have done/helped with brake work on his friends and brother's cars.¹³³ He reported that he could easily do one brake job a year on his own vehicles up until 2003; also, during the time that he was a mailman and used his own vehicle from 1988 to 2010, he did two or three brake jobs a year.¹³⁴

¹²² Deposition of Victor Coffin, Volume 1, September 17, 2018, page 46, 48, 52

¹²³ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 50

¹²⁴ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 64

¹²⁵ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 47, 49

¹²⁶ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 48

¹²⁷ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 447-449

¹²⁸ Deposition of Victor Coffin, Volumes 1 & 2, September 17 and 18, 2018, page 54, 439

¹²⁹ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 454

¹³⁰ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 455

¹³¹ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 464

¹³² Deposition of Victor Coffin, Volume 2, September 18, 2018, page 441-444

¹³³ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 61-62

¹³⁴ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 58, 60

Clutch Replacement Jobs

40. The first time Mr. Coffin did clutch work was on his MGB sports car in which he put in two clutches in 1968/1969 timeframe; over the 35 years he owned this car, he recalled having put in three or four total clutches.¹³⁵ He reported having done clutch work less than a total of 10 times during his lifetime.¹³⁶ The last time he would have done any clutch work would have been in 1973/1974 on a Toyota Land Cruiser.¹³⁷

Gasket Jobs

41. Mr. Coffin's work on gaskets involved head gaskets and exhaust gaskets on the manifold.¹³⁸ He also worked on donut type gaskets between sections of the exhaust system, between a catalytic converter and the muffler.¹³⁹ He estimated having done a total of 20-25 gasket related jobs; he only recalled having worked with Feltmate gasket but could not recall other brands.¹⁴⁰ He reported that Feltmate gasket came in a kit and that everything came precut and predrilled and ready to install.¹⁴¹

EXPOSURE AND POTENTIAL RISKS WILL VARY SUBSTANTIALLY AMONG INDIVIDUALS BASED ON MULTIPLE CHARACTERISTICS

42. There are many meaningful factors to be assessed that can influence an individual's exposure, dose received, and potential risk to asbestos. These can include but are not limited to:

- Work history of the subject
- Exposure to various chemicals/materials/physical hazards associated with the risk of developing mesothelioma
- Age at exposure
- Magnitude of exposure
- Duration and frequency of exposures
- Typical respiratory rate associated with relevant tasks
- Defining realistic exposure scenarios that are applicable to the subject
- Identifying epidemiological studies that support the disease outcome (mesothelioma) at the concentrations encountered by the subject

¹³⁵ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 66

¹³⁶ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 63-64

¹³⁷ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 65

¹³⁸ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 66

¹³⁹ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 67

¹⁴⁰ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 68

¹⁴¹ Deposition of Victor Coffin, Volume 1, September 17, 2018, page 69

- Assessment of possible other exposure scenarios

Chemical Characteristics/Types of Asbestos

43. Asbestos is a generic term used to describe a subset of crystalline mineral silicate fibers that vary in crystal structure and mineral content.¹⁴² These include chrysotile, which is a serpentine mineral as well as five amphibole minerals—amosite, crocidolite, actinolite, tremolite, and anthophyllite.¹⁴³ The structure of these silicate minerals can be fibrous or non-fibrous. When they have relatively large ratios of length to width, they are considered to be in the “asbestiform” habit.¹⁴⁴ The type (chemical nature), concentration, and dimensions of asbestos fibers greatly influence the risk of developing asbestos-related disease. There are specific exposure concentrations for various asbestos types that will pose an insignificant risk upon inhalation. Hodgson and Darnton (2000)¹⁴⁵ did an extensive review of mortality reports on asbestos-exposed populations and concluded that the relative potency for causing mesothelioma by the commercial asbestos types, chrysotile, amosite, and crocidolite, is in the ratio of 1:100:500 respectively. Their estimate also assumed that the commercial chrysotile may be contaminated by tremolite. Berman and Crump (1995)¹⁴⁶ also showed that the best estimate for the potency of chrysotile for causing mesothelioma to be hundreds of times less than that of the amphiboles.

44. A detailed review of the exposure-response literature has been published, that looked primarily at chrysotile-exposed cohorts in industrial settings to evaluate a “no-effect” exposure level for development of lung cancer and mesothelioma. The authors found that a cumulative exposure range of 15 – 500 fibers per cubic centimeter per year (f/cc-yr.) is a useful surrogate for a no observed adverse effect level (NOAEL) for the potential risk of developing asbestos related mesothelioma of the lung.¹⁴⁷ With respect to mesothelioma, Berman and Crump reported that the best estimates for the relative potency of chrysotile ranged from zero to about 1/200th that of amphibole asbestos.¹⁴⁸

¹⁴² Lippmann M. 2014. Toxicological and epidemiological studies on effects of airborne fibers: Coherence and public health implications. *Critical Reviews in Toxicology*, 44:8,643-695

¹⁴³ International Agency for Research on Cancer. 2012. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, No. 100C. Asbestos (Chrysotile, Amosite, Crocidolite, Tremolite, Actinolite and Anthophyllite)

¹⁴⁴ Lippmann M. 2014. Toxicological and epidemiological studies on effects of airborne fibers: Coherence and public health implications. *Critical Reviews in Toxicology*, 44:8,643-695

¹⁴⁵ Hodgson JT, Darnton A. 2000. The quantitative risks of mesothelioma and lung cancer in relation to asbestos exposure. *Annals of Occupational Hygiene*, 44:565-601.

¹⁴⁶ Berman DW, Crump KS, Chatfield EJ, Davis JM, Jones AD. 1995. The sizes, shapes, and mineralogy of asbestos structures that induce lung tumors or mesothelioma in AF/HAN rats following inhalation. *Risk Analysis*, 15(2):181-95.

¹⁴⁷ Pierce JS, McKinley MA, Paustenbach DJ, Finley BL. 2008. An evaluation of reported no-effect Chrysotile asbestos exposures for lung cancer and mesothelioma. *Critical Reviews in Toxicology*, 38:191-214.

¹⁴⁸ Berman DW, Crump KS. 2008. Update of potency factors for asbestos-related lung cancer and mesothelioma, *Critical Reviews in Toxicology*, 38:sup1, 1-47.

45. The fiber type historically used in asbestos cement boards, brake pads, and engine gaskets was chrysotile.^{149,150} Yarborough's review of exposure to high concentrations of chrysotile fibers not contaminated with amphiboles did not support a conclusion of causation.¹⁵¹ As described above, chrysotile is generally considered to present a negligible risk for development of mesothelioma, as opposed to the other commercially available forms of asbestos, which are amphiboles.

Review of the Relevant Scientific Literature with Respect to Incidental Exposure to Asbestos Cement Board Dust, Performance of Mechanic Work on Specific Mechanical Components, and Development of Cancer or Mesothelioma Due to Exposure to Asbestos

46. My review of the available published literature reveals no case studies or exposure assessments specific to incidental/bystander exposures to asbestos containing cement board dust or mechanic service work, associated with heavy equipment and asbestos found in their associated brake pads. Governmental agencies and researchers have carried out exhaustive studies since the 1960s to identify those products, activities, and environments that contained asbestos, created an airborne exposure to asbestos, and presented a risk to those populations that would encounter it. This included evaluating direct workplace exposures and those that are termed "bystander" exposures, whether they occurred in an occupational setting, in the community, or in a "take home" residential setting. The focus of the scientific literature reflects that workers and residents in asbestos cement containing structures are not at risk for consequential exposure as a result of routine activities.

47. My review of the literature also found that the preponderance of epidemiological studies clearly showed no increased rates of mesothelioma, among full-time mechanics servicing automobiles and trucks, that routinely performed brake replacements and/or gasket replacements, as part of the engine rebuilding process.^{152,153,154} Mr. Coffin's incidental exposure and very limited active work during his time as a Bridge Operator, at the Carlton Bridge, would be even less of a risk to provide any potential exposures that would be of physiological significance, since they

¹⁴⁹ Jacko MG, DuCharme RT. 1973. Brake emissions: Emission measurements from brake and clutch linings from selected mobile sources. Conference: National Automobile Engineering Meeting, February 1973.

¹⁵⁰ Blake CL, Dotson GS, Harbison RD. 2006. Assessment of airborne asbestos exposure during the servicing and handling of automobile asbestos-containing gaskets. *Regulatory Toxicology and Pharmacology*, 45(2):214-22.

¹⁵¹ Yarborough CM. 2007. The Risk of Mesothelioma from Exposure to Chrysotile Asbestos. *Current Opinion in Pulmonary Medicine*, 13(4):334-8.

¹⁵² Teschke K, Morgan MS, Checkoway H, Franklin G, Spinelli JJ, van Belle G, Weiss NS. 1997. Mesothelioma surveillance to locate sources of exposure to asbestos. *Canadian Journal of Public Health*. 88 (1)163 – 168.

¹⁵³ Garabrant, DH, Alexander DD, Miller PE, Fryzek JP, Boffetta P, Teta MJ, Hessel PA, Craven VA, Kelsh MA, Goodman M. 2016. Mesothelioma among motor vehicle mechanics: An updated review and meta-analysis. *Ann. Occup. Hyg* 60(1):8-26.

¹⁵⁴ Laden F, Stampfer MJ, Walker AM. 2004. Lung cancer and mesothelioma among male automobile mechanics: A review. *Reviews on Environmental Health*. 19(1)39-61.

would be so much lower and infrequent when compared to those previously cited assessments of full-time mechanics, who were directly and routinely servicing large numbers of vehicles.

Exposure Factors Relevant to Mr. Victor Coffin and Reported Exposures Associated with His Time Working as a Bridge Operator

48. Several published articles have been reviewed that report on personal and area air samples collected during periods of time when heavy equipment and heavy truck brake pads were removed and replaced. Although not specifically related to bridge braking systems, the various heavy equipment exposure characterizations are analogous to possible exposures that would be encountered during typical brake repair activities associated with bridge equipment.

49. Of the published reports reviewing the presence of fibers in the workplace, I will utilize two in developing the potential exposure scenarios relevant to Mr. Coffin's work experience on the Carlton Bridge. One summarized the relevant literature evaluating possible exposure to heavy equipment mechanics from brake dust, during change out and replacement, while another assessed the potential exposures during servicing of automobile asbestos containing brakes, which would be a "worst-case" analogy for servicing the barrier brakes he described.^{155,156} These studies are consistent with others found in the published literature^{157,158,159} that showed that exposures to workers and mechanics that regularly undertook these types of repairs on heavy equipment and heavy trucks, were far below any levels that would be considered hazardous, even when compared against the most stringent exposure control guidelines and standards.

50. Mr. Coffin also related that he was present in the Machine Room when other workers removed a section of ceiling/wall that was approximately two feet by four feet to repair a leaking pipe. Mr. Coffin was not the primary individual performing the work on the removal and repair of AC board wall panels, but rather he was an observer/bystander of the work activities by others¹⁶⁰ and only indirectly participated and "helped with the clean-up".^{161,162} For example, in a study where AC board was removed from a wall structure, the bystander's exposure (the subject was within 1.5 meters of the work activity) during the active cutting and removal of the wall board,

¹⁵⁵ Paustenbach DJ, Ritchter RO, Finley BL, Sheehan PJ. 2003. An evaluation of the historical exposures of mechanics to asbestos in brake dust. *Applied Occupational and Environmental Hygiene* 18:786-804.

¹⁵⁶ Madl AK, Gafeney SH, Balzer JL, Paustenbach DJ. 2009. Airborne Asbestos Concentrations Associated with Heavy Equipment Brake Removal. *Annual Occupational Hygiene* 53 (8) 839-857.

¹⁵⁷ Spencer JW, Plisko MJ, Balzer L.1999. Asbestos Fiber Release from the Brake Pads of Overhead Industrial Cranes. *Applied Occupational and Environmental Hygiene* 14 (6) 397 – 402.

¹⁵⁸ Blake CL, Van Orden DR, Banasik M, Harbison RD. 2003. Airborne asbestos concentration from brake changing does not exceed permissible exposure limit. *Regulatory Toxicology and Pharmacology*,38(1):58-70.

¹⁵⁹ Spencer JW, Plisko MJ, Balzer L.1999. Asbestos Fiber Release from the Brake Pads of Overhead Industrial Cranes. *Applied Occupational and Environmental Hygiene* 14 (6).

¹⁶⁰ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 329-330, 507

¹⁶¹. Deposition of Victor Coffin, Volume 2, September 18, 2018, page 330-331

¹⁶² Deposition of Victor Coffin, Volume 2, September 18, 2018, page 509-510

ranged between 0.01 and 0.02 f/cc, during the active work period. The personal sample obtained on an individual during the clean-up activity was 0.9 f/cc.¹⁶³ This simulation would likely be higher than Mr. Coffin's general clean-up exposure since this simulation had the subject collecting and bagging a significant amount of freshly cut AC board debris, as opposed to the very limited exposure Mr. Coffin described in his deposition.

51. Therefore, based on information provided by Mr. Coffin in his deposition, the scenarios that would describe how the Plaintiff could be potentially exposed to asbestos, originating from his activities associated with his time of employment for the Maine Central Railroad during the time period of the second half of 1967 and between 1971 and 1987, would be:

- a.) Being present in a physical structure (Control Room, Engine Room and Maintenance Room) constructed of AC boards.
- b.) A "bystander exposure" while being present and in a room where AC boards were removed, and then performing clean-up of the room for approximately 20 minutes after completion of the removal task by others.
- c.) Assisting with the replacement of brake pads on the bridge lift mechanism, twice.
- d.) Replacement of each of the four "barrier" brakes, four times.

RESULTS OF AN EXPOSURE MODEL SPECIFIC FOR MR. COFFIN'S STATED HISTORY OF WORK FOR MCR AND DEMONSTRATED NO AIRBORNE HAZARD EXISTED

Working in a Structure Constructed of AC Boards Bystander Exposure for Engine Rebuilding and Brake Replacement

52. The exposure reconstruction of relevant work performed by the Plaintiff is based on the testimony of Mr. Coffin. It relates to the time period of the second half of 1967 and between 1971 and 1988, and can be summarized as follows:

Time period- The Plaintiff was a Bridge Operator for approximately 17.5 years. During that time period he would spend the majority of his time in the various structures associated with the Carlton Bridge, although he did routinely perform service repairs outside of those environments.

Frequency- Although Mr. Coffin was not specific in the number of months he worked on the Carlton Bridge each year, his deposition testimony states that he was there nearly full-time, except for periods during the winter when he would be laid off, or transferred back to the Rigby or the

¹⁶³ ASEA Reports. 2016. Measurement of asbestos fibre release during removal works in a variety of DIY scenarios. Prepared by Monash University. Asbestos Safety and Eradication Agency, Australian Government.

Main Yard, for an unspecified period of time. To be conservative, we will assume that Mr. Coffin worked on the Carlton Bridge for a maximum of 46 weeks per year (assuming 10 days vacation, 10 days holiday and 10 days of winter furlough, or other temporary assignment) to develop a “high” potential exposure scenario.

Duration- Although there is no specific information provided by Mr. Coffin as to how long his required maintenance on the bridge would require him to be out of the various bridge enclosures, we will assume that he spent 100 percent of his time within the structures, and this will be utilized in these calculations because it will contribute to providing a highly conservative exposure estimate.

Magnitude of Exposure- No documents were identified that discussed exposure to asbestos fibers from AC board constructed buildings. The structure under consideration was placed into service in 1927 and had been continuously used until it was decommissioned in approximately 2000. The building had been in continuous use for more than 40 years before Mr. Coffin first worked there. There was no record of it requiring repair or replacement during that time period. The building, as described by Mr. Coffin, was constructed in accordance with reasonable and prevailing building practices of the time, including a double wall, frame construction. Mr. Coffin did not cite any damage to the walls of the structure, and further cited that the walls had been painted several times and were reported to be smooth and in good condition.¹⁶⁴ The painted surfaces would serve to further encapsulate the asbestos contained in the AC boards. Mr. Coffin discussed vibration of the walls related to railway and automobile traffic, and in hindsight wondered if the vibration could have potentially caused the AC boards to rub against each other and release fibers. There is no evidence presented that indicated that this action ever occurred, or that the panels had any friable materials present. The seams between the panels were not visible to Mr. Coffin, since he testified that they were covered with a piece of trim.¹⁶⁵ Mr. Coffin’s recollection of cleaning dust in the enclosures cannot be used to demonstrate that asbestos fibers were released, or present, since “dust” is not a specific indicator for asbestos fibers and is very prevalent along rail tracks and roadways; generic roadway dust can be suspended in air by the motion of vehicular or train traffic and may have nothing to do with asbestos releases from a structure. However, as done previously, I have assumed a “worst case” scenario to test the hypothesis that Mr. Coffin may have been exposed to asbestos fibers during his work on the Carlton Bridge. The “high” estimate was considered to be the average of urban background (0.0005 f/cc)¹⁶⁶ and the “low” estimate was the median for rural background (0.00002 f/cc).

¹⁶⁴ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 508

¹⁶⁵ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 508

¹⁶⁶ Abelmann, et al., 2015 Historical ambient airborne asbestos concentrations in the United States - an analysis of published and unpublished literature (1960s-2000s). *Inhal Toxicol.* 2015;27(14):754-66.

Direct Exposure for Reported Brake Replacement

53. Madl et al.,¹⁶⁷ evaluated the potential exposure to individuals that were doing regular brake jobs on automobiles and heavy equipment. These can be used as analogous exposure estimates for Mr. Coffin's work on the brakes on Carlton Bridge. Therefore, the magnitude of direct exposure for an individual, like Mr. Coffin during the removal and replacement of brake pads on the Barrier Gates will be estimated by those studies associated with automobile brakes, and the brake mechanism for the draw bridge, by use of brake replacement on heavy equipment.

Direct Exposure Scenario (lift mechanism brake replacement)- high: This would involve being present for two lift mechanism brake replacements for a duration of two hours each at an exposure of 0.09 f/cc.

Direct Exposure Scenario (lift mechanism brake gasket replacement)- low: This would involve being present for two brake replacements for a duration of two hours each at an exposure of 0.044 f/cc.

Direct Exposure Scenario (barrier gate brake replacement)- low: This would involve being present for four brake replacements during his employment for a duration of one and a half to two hours each at both ends of the bridge at a worker personal concentration of 0.03 f/cc.

Direct Exposure Scenario (barrier gate brake replacement)- high: This would involve being present for four brake replacements during his employment, for a duration of one and a half to two hours each at both ends of the bridge at a worker personal concentration of 0.09 f/cc.

Table One- Estimates for lifetime direct cumulative dose associated with Mr. Coffin's work as a Bridge Operator for MCR on the Carlton Bridge compared to lifetime dose associated with the 1986 OSHA PEL of 0.2 f/cc and the current OSHA 8-hour PEL of 0.1 f/cc exposure to asbestos.

¹⁶⁷ Madl AK, Gafeney SH, Balzer JL, Paustenbach DJ. 2009. Airborne Asbestos Concentrations Associated with Heavy Equipment Brake Removal. *Annals of Occupational Hygiene*, 53 (8) 839-857.

Task	Time Period (Weeks)	Frequency of Event (Days/Week)	Duration of Event (Hours/day)	Exposure Factor (f/cc)	Cumulative Exposure (f/cc-hr.)	Cumulative Exposure (f/cc-yr.)
Brake Replacement						
Lift (H)	2	1	2	0.09	0.36	0.00018
Lift (L)	2	1	2	0.044	0.176	0.00009
B. Gates (H)	4	1	4	0.090	1.44	0.00072
B. Gates (L)	4	1	4	0.030	0.48	0.00024
Maintenance Room Repair Work						
Bystander (H)	1	1	4	0.02	0.08	0.00004
Bystander (L)	1	1	4	0.01	0.04	0.00002
Clean-up	1	1	0.33	0.9	0.297	0.00015
Bridge Operator						
Indoor (H)	840	5	8	0.0005	168	0.0084
Indoor (L)	840	5	8	0.00002	0.672	0.00034
Regulations						
1986-8-hr. PEL (OSHA)	840	5	8	0.2	67,200	33.6
1994-Current 8-hr. PEL (OSHA)	840	5	8	0.1	33,600	16.8
f/cc = fiber per cubic centimeter hr. = hour yr. = year (H) = High Estimate (L) = Low Estimate PEL = Permissible Exposure Limit OSHA = Occupational Safety and Health Administration						

Calculating MCR Work Associated Lifetime Exposure (cumulative):

Based on realistic, but highly conservative assumptions regarding the relative time period, frequency, duration, and exposure concentrations, the calculations detailed in Table One result in a cumulative exposure with a range from 0.00084 f/cc-yrs. to 0.00958f/cc-yrs. for the Plaintiff's possible exposure to asbestos containing materials during the 17.5 year period in which Mr. Coffin reportedly worked as a Bridge Operator on the Carlton Bridge.

A comparison of the potential cumulative exposure of the Plaintiff, with occupational exposure limits for airborne asbestos compared to his potential exposure risks associated with asbestos resulting from exposure to asbestos fibers associated with his work as a Bridge Operator, is negligible. As a point of comparison, Mr. Coffin's actual cumulative exposures would have been between 3.500 to 40,000 times lower than the most stringent occupational exposure regulations

and guidelines that were in effect at the time of his employment, as well as 1,700 to 20,000 times below the most stringent regulations that are currently in effect.

Comparison to Regulatory and Professional Standards in Force During Mr. Coffin's Relevant Work Period with MCR

54. The American Conference of Governmental Industrial Hygienists (ACGIH), was established in 1938 (originally known as the National Conference of Governmental Industrial Hygienists), by a group of industrial hygienists working at various state, city, and federal agencies, including the United States Public Health Service. A major charge that they undertook was to review the scientific literature and suggest exposure limits that would be protective of worker health. These exposure limits were widely employed and periodically reviewed as new information became available. They provided guidance for asbestos exposure limits that were widely used throughout industry until OSHA was formed in 1971. These exposure limits, that they termed "Threshold Limit Values" (TLVs), were intended to represent concentrations under which "nearly all workers can be employed for their entire working lifetime without adverse effect."¹⁶⁸

55. In 1968 the ACGIH published a Notice of Intended Change for its asbestos TLV with a proposal to reduce the standard to 2 million of particles per cubic foot (mppcf) or 12 f/cc as an 8-hour Time Weighted Average (TWA).¹⁶⁹

56. In 1969, the Walsh Healey Public Contracts Act adopted the 1968 ACGIH TLVs including the Notice of Intended Change for Asbestos of 12 f/cc.

57. In 1970, the ACGIH published a Notice of Intended Change to its asbestos TLV which proposed to reduce the 8-hour TWA to 5 f/cc and to include a "Ceiling Limit" of up to 10 f/cc which could occur for no more than 15 minutes each hour for up to five times in an 8-hour workday.¹⁷⁰

58. The Occupational Safety and Health Administration (OSHA), was formed in May of 1971 by an act of Congress and set about to develop regulations for limiting workplace exposure to specific chemicals, including asbestos, and termed them Permissible Exposure Limits (PELs). The table below provides a summary of OSHA's regulations for airborne asbestos.

¹⁶⁸ Proceedings of the 8th Annual Meeting of the ACGIH: TLV Committee Report, Chicago, IL., April 7-13, 1946.

¹⁶⁹ Transactions of the 30th Annual Meeting of the ACGIH, St. Louis, MO. May 12-14, 1968.

¹⁷⁰ Transactions of the 32nd Annual Meeting of the ACGIH, Detroit, MI. May 10-12, 1970.

Table Two History of OSHA Asbestos Standards

Date	Standard	Notes
5/29/1971	12 f/cc TWA	8 hr. TWA
12/7/1971	5 f/cc TWA; 10 f/cc Ceiling	Emergency Temporary Standard (ETS); 8 hr. TWA; 15 min ceiling
6/7/1972	5 f/cc TWA; 10 f/cc Ceiling	8 hr. TWA; 15 min ceiling
7/1/1976	2 f/cc TWA	8 hr. TWA
6/20/1986	0.2 f/cc TWA	8 hr. TWA, Action Level = 0.1 f/cc
9/14/1988	1 f/cc - Ceiling	30 min Excursion Limit
8/19/1994	0.1 f/cc TWA	8 hr. TWA
hr.	hour	
min	minute	
OSHA	Occupational Safety and Health Administration	
f/cc	fibers per cubic centimeter	
TWA	time weighted average	
TLV	Threshold Limit Value	

59. The airborne concentrations calculated and detailed in Table One, used realistic and appropriate exposure scenarios that were developed from Mr. Coffin's deposition testimony and the relevant scientific literature show that the resulting concentrations would fall well below any of the pre-existing 8-hour time weighted averages that were in place at any point during his employment by the MCR. This also includes the current OSHA Permissible Exposure Limit of 0.1 fibers/cc as well as the current OSHA permissible 30-minute Excursion Limit of 1.0 fibers/cc. Further, a sensitivity analysis on this approach demonstrates that the maximum emissions Mr. Coffin would have experienced, as described in his deposition testimony, would still result in an airborne concentration of asbestos that would be well below the OSHA standards that were in place during his employment with the MCR as well as the stringent OSHA guidelines that are currently in place.

Alternative Theories of Causation

60. Mr. Coffin reported significant activities associated with work he performed as a child and as a young man, both with his father and by himself, while doing different types of construction work around the personal residences that utilized the demolition, cutting and reuse of

AC board and shingles, as well as other asbestos containing products. Work in the construction industry has been shown to be associated with an increased risk of developing mesothelioma.¹⁷¹

61. Mr. Coffin reportedly did extensive work on military aircraft, both helicopters and planes, during his time in the Navy. It is well established that military aircraft contained asbestos in numerous applications as insulation, soundproofing, and fire protection. Furthermore, military aircraft of the vintage coinciding when Mr. Coffin was in the military had asbestos insulation on its wiring,¹⁷² which Mr. Coffin dealt with on a routine basis while in the service.

62. Mr. Coffin also described how he worked with refractory cement in a commercial setting when he was furloughed during winter months while working for MCR over a period of six to eight years. Refractory cement contains high percentages of asbestos fibers that were primarily chrysotile. Furthermore, Mr. Coffin discussed how he removed a large boiler from a multifamily residence by breaking apart the cement that encased it with a sledge hammer. Mr. Coffin believed that the cement was an asbestos insulating cement. This very physical work would have taken place in extremely close quarters with little ventilation which would have generated significant amounts of respirable dust that likely contained significant amounts of asbestos fibers.

63. Mr. Coffin worked for the U.S. Postal Service out of the Brunswick Facility. Reports provided from that facility show that extensive asbestos containing materials were present in the facility, in a damaged and friable state, prior to the extensive remediation actions that were performed there.¹⁷³ The materials were documented to contain both chrysotile and amphibole asbestos.

64. Mr. Coffin also described how he did extensive work on his vehicles throughout his adult life— changing brakes and replacing clutches and engine gaskets.

65. Mr. Coffin noted that the Bath Iron Works (BIW) was located near the bridge, within a quarter of a mile, according to Mr. Coffin’s approximation.¹⁷⁴ Mr. Coffin reported that during the summer months, the windows were all open in the control room and wind would generally come from the south and BIW was south of the Bridge.¹⁷⁵ Mr. Coffin believes that he could have been exposed to the airborne asbestos fibers drifting from BIW when they worked in

¹⁷¹ McDonald AD, McDonald JC. 1980. Malignant Mesothelioma in North America. *Cancer*.46:1650-1656

¹⁷² Advisory Circular. 2013. Aircraft Wiring and Bonding.AC 21-99(1). Annex D to Section 2, Chapter 1, MIL-DTL-25038 wire, Electrical, High Temperature, Fire Resistant and Flight Critical, General Specification. Civil Aviation Safety Authority, Australian Government .

¹⁷³ URS Corporation’s Asbestos & Lead-Based Paint Compliance Audit Report from March 2005 for Brunswick Post Office.

¹⁷⁴ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 318-319

¹⁷⁵ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 319

the hulls of ships.¹⁷⁶ Naval ships often utilized the far more potent forms of amphibole asbestos, primarily amosite, extensively throughout their ships.

Relevant Dose Response Considerations

66. For virtually every substance, the dose to which an individual is exposed relates to the likelihood that a physiological effect will be observed. Current literature supports the presence of a “threshold dose” for chrysotile, below which there would be no causal risk for developing mesothelioma. The exposures Mr. Coffin may have received from his very limited direct activities associated with being a Bridge Operator on the Carlton Bridge would have been far below the threshold exposure. This is due to the very low cumulative exposure that he could have received as well as the type of asbestos that was present.¹⁷⁷.

67. The Pierce et al., 2008 review¹⁷⁸ summarizes the cumulative exposure-response data reported for predominantly chrysotile-exposed cohorts in the available literature and found that for predominantly chrysotile exposures, the cumulative “no-effects” exposure levels for mesothelioma fell between 15–500 f/cc-yr. Therefore, the No Observed Adverse Effect Level found in the literature was between approximately 1,500 to more than 50,000 times greater than the maximum cumulative exposure value calculated for the Plaintiff, Mr. Coffin, over the maximum period of time that he would have been employed as a Bridge Operator by the MCR.

CONCLUSIONS

68. In addition to the opinions expressed above, my principal conclusions, to a reasonable degree of scientific certainty, include the following:

- a) The Plaintiff’s incidental exposure to airborne asbestos fibers originating from his work as a Bridge Operator, while employed by MCR was very low and consistent with the lower estimates of normal employment in an industrial setting. None of Mr. Coffin’s potential exposures would have exceeded, or approached, the most stringent regulations that were in place at the time of his employment or even those that are in force at this present time.
- b) Analysis of relevant data compiled from analogous studies of mechanics and other occupations, application of standard industrial hygiene methodologies, in

¹⁷⁶ Deposition of Victor Coffin, Volume 2, September 18, 2018, page 320

¹⁷⁷ Roggli VL. 2007. Environmental asbestos contamination: What are the risks? *Chest*, 131:336-338

¹⁷⁸ Pierce JS, McKinley MA, Paustenbach DJ, Finley BL. 2008. An evaluation of reported no-effect Chrysotile asbestos exposures for lung cancer and mesothelioma. *Critical Reviews in Toxicology*, 38:191-214.

addition to comparison with results found in published literature, do not support the contention that there is a health hazard associated with the low level asbestos cumulative exposure encountered by the Plaintiff via the incidental exposures, that would have occurred from his work as a Bridge Operator on the Carlton Bridge. This is true even when using extremely conservative assumptions that would tend to bias the calculated results toward a higher potential exposure.

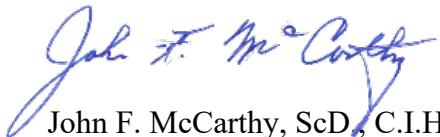
- c) Any exposure to asbestos from Mr. Coffin's reported time around the activities associated with brake replacement while working at the Carlton Bridge, would have been far less (by several orders of magnitude) than the potential dose received by full-time mechanics. This is significant since the vast majority of epidemiological studies have shown no statistically meaningful association with automobile, heavy equipment, or heavy truck mechanics and a risk of developing mesothelioma. These epidemiological study findings of no association are very robust due to their consistency between various study designs, their consistency over time (multiple decades), and their consistency between various nationalities and continents.
- d) There is no evidence or testimony presented that show/describe that there was physical damage or abrasion to any of the boards/panels that were used to construct the enclosures on the Carlton Bridge. AC board was a common building material that was used in thousands of structures around the globe for decades and due to the immobilization and encapsulation of the asbestos fibers in the body of the board was not, and is not, considered to pose a risk except when it is cut or demolished. The limited cutting that took place on the panels did not present a meaningful risk to Mr. Coffin.
- e) The specific type of asbestos that was used in the AC Boards, that were produced in the 1920 to 1930-time frame, was specified to be chrysotile. This form of asbestos has been shown to have a negligible potential to cause mesothelioma as opposed to the amphibole types.
- f) There was no information presented in the documentation review that indicated that Mr. Coffin would have been exposed to amphiboles as part of his work at the Carlton Bridge.

In addition to the materials specifically cited above, I reviewed the materials listed in Appendix B for my evaluation and in formulating my opinion.

I reserve the right to supplement my report if additional data or information becomes available in the future.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on January 6, 2020, in Newton, Massachusetts.

By:

A handwritten signature in blue ink, appearing to read "John F. McCarthy".

John F. McCarthy, ScD, C.I.H.

Attachments:

Appendix A JFM *Curriculum Vitae*

Appendix B Documents Relied Upon for Expert Opinion

APPENDIX A

JOHN F. MCCARTHY, S.C.D., C.I.H. – CURRICULUM VITAE

JOHN F. McCARTHY, Sc.D., C.I.H.

PRESIDENT

BACKGROUND SUMMARY

1988 – President, Environmental Health & Engineering, Inc.
1992 – Lecturer, Dept. of Environmental Health, Harvard School of Public Health
1980 – 1987 Research Scientist/Director, Aerosol Characterization Laboratory, Massachusetts Institute of Technology
1978 – 1980 Research Scientist, Massachusetts Institute of Technology

EDUCATION

Sc.D. Environmental Science and Physiology, Harvard University, 1987
M.S. Environmental Health Sciences, Harvard University, 1978
B.S. Biology, Boston College, 1973

PROFESSIONAL REGISTRATION

American Board of Industrial Hygiene Certified: Comprehensive Practice

PROFESSIONAL AFFILIATIONS

American Industrial Hygiene Association
International Society of Indoor Air Quality and Climate
American Society for Testing and Materials
American Conference of Governmental Industrial Hygienists
American Society of Healthcare Engineers

COMMITTEE MEMBERSHIP

American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Inc.
IAQ 2004 Conference Chairman
American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Inc.
Guideline Project Committee 10 P, Criteria for Achieving Acceptable Indoor Environments
National Academy of Sciences
Standing Committee on Medical and Epidemiological Aspects of Air Pollution on U.S. Government Employees and their Families
Harvard T.H. Chan School of Public Health
Board of Directors, Center for Global Health and the Environment



EXPERIENCE

As President of Environmental Health & Engineering, Inc. (EH&E), Dr. McCarthy has led investigations for a wide variety of exposures to toxic pollutants and infectious agents and their associated health effects. His work has focused on the analysis of pollutants originating from both outdoor and indoor sources, as well as pollutant transport through various media. He specializes in problem identification and assembly and management of interdisciplinary teams to address the various areas of concern that arise with different clients. Dr. McCarthy provides technical and administrative design direction to the study team, including the development and application of novel analysis techniques and the implementation of field monitoring studies. Relevant air quality experience includes the following:

Ambient Environments

Directed air quality impact assessment of Central Artery Vent Building No. 3 on surrounding community. Performed air quality studies including risk assessment for dispersion modeling of NO₂, CO, and PM₁₀ impacts. The work supported an air rights development of property owners and required close interaction with CA/T and Massachusetts Department of Environmental Protection (MADEP).

Provided air quality modeling, risk assessment and atmospheric monitoring of CO, NO₂ and PM₁₀ for an apartment/hotel complex to assess potential impact of relocating an access ramp and rerouting vehicular traffic due to CA/T construction.

Provided risk assessment and environmental impact analysis of proposed roadway construction around the Massachusetts General Hospital and Spaulding Rehabilitation Hospital. The work involved negotiating appropriate air quality action levels with MADEP and development of mitigation strategies. As a follow-on project to this, Dr. McCarthy developed and implemented an atmospheric sampling program to verify compliance of the construction program with control measures.

On behalf of the CA/T, principal-in-charge of an air quality impact assessment for the City of Boston's East Boston community during construction of the Third Harbor Tunnel and proposed construction of a hazardous waste incinerator. This involved dispersion modeling and analysis, risk assessment and risk communication.

Principal-in-charge of development of a comprehensive air monitoring program and community impact evaluation for development of a 78-acre contaminated property. In addition to developing a complex monitoring network, this work involved developing appropriate air quality action levels and mitigation measures for permit hearings. This has also involved community liaison and negotiations with state and local authorities.

Directed detailed analysis of the University of Vermont's medical incinerator for an air permit. This work involved assessing possible emissions, providing dispersion analysis, and risk characterization.

For the City of Boston, performed a detailed line source analysis of rerouting traffic due to CA/T activities.

For the City of Cambridge, performed a detailed analysis including atmospheric dispersion analysis and risk assessment for bridge construction and resultant traffic for Charles River span (Scheme Z).

Conducted a detailed analysis of impact of exhaust stack emissions for the University of Cincinnati. This work involved developing a near-field dispersion model, site monitoring to validate performance and making mitigation recommendations.

Principal-in-charge of a detailed analysis and monitoring study (CO, NO₂, PM_{2.5}, elemental carbon, speciated VOCs) to characterize exposure of toll collectors to vehicular traffic.

Led a detailed reconstruction of exposure to combustion byproducts of a potentially impacted population using atmospheric modeling after a truck fire which involved hazardous materials. This involved profiling truck contents, estimating emissions rate and dispersion of combustion byproducts and determining estimates of exposure at the receptor locations.

Led the analysis of the environmental impacts from roadway emissions during a major five highway study in Las Vegas, Nevada. This work involved detailed characterization of air toxics, air quality modeling, and identification of highest impact areas. Continuing work involved development and implementation of remedial measures as part of a settlement program.

Product Evaluation

Served as Principal Investigator of a two-year, multi-phased investigation of "Chinese Drywall" conducted on behalf of the U.S. Consumer Product Safety Commission. The investigation included: identification of markers of problem drywall, in-home evaluations of environmental quality and corrosion, health impact analyses, chamber-testing of drywall samples to identify emissions and corrosion rates, evaluations of drywall from domestic (U.S.) suppliers, and an assessment of temporal variability of conditions in homes.

Directed a major product evaluation for a national retailer, manufacturer and importer of clothing to determine formaldehyde emission rates from various clothing materials. The assignment involved determining emissions utilizing controlled environmental chambers under both static and dynamic conditions, performing a sensitivity analysis over a wide range of temperatures and humidities, and recommending limits of acceptability for materials.

For the Commonwealth of Massachusetts, performed a detailed analysis on a number of waterproofing products that had been used in a major state facility that were not performing properly. Through comparison with ambient samples and headspace analysis of various products to identify specific chemical agents, the problem material was isolated and identified. Additional dynamic analyses of building system mockups in environmental chambers permitted precise determination of product cure time to be made.

Developed and oversaw a series of quantitative tests to verify the performance of nano-tube filters designed for use in the pharmaceutical and semi-conductor industries. This program involved evaluating capture efficiency for a range of sub-micron particles as well as the potential for the “shedding” of materials into the airstream during equipment start-up or pulsations in the system.

Principal-in-charge of a study to evaluate the potential release of airborne fibers during maintenance activities of a variety of household appliances. This work involved collecting source, personal and area samples during well-characterized maintenance activities in a large exposure chamber under a range of ventilation conditions. The samples were analyzed using various analytical techniques to permit direct comparison with other historical studies. Project included developing time-activity exposure pattern profiles for maintenance workers.

For a major equipment manufacturer, performed a detailed evaluation of removal of various air pollutants by a new, innovative pollutant removal technology. This involved development of a fully instrumented, 1700 square foot test house/chamber in which several pollutants, including gases, particles, and biological agents, could be precisely released over time and their removal rate accurately monitored. In this multi-phase interventional study a program was designed to determine system efficacy and a corresponding performance model was developed.

For a large urban teaching hospital, developed an evidence based design guide for new orthopedic operating rooms based on control of airborne infectious agents. This involved evaluating the international scientific literature regarding infections from airborne particles, critically reviewing current design guides and their underlying rationale, developing a reproducible test procedure that can be used to characterize the control of potentially infectious particles, and using the testing protocol to compare the effectiveness of the various designs located at multiple institutions.

Developed a controlled chamber test to determine the emission rate of silica and respirable dust from various concrete cutting tools under varying environmental conditions. This test also provided information on particle size distributions associated with various operations.

For a major university, led a multidisciplinary team in developing a detailed characterization study regarding potential exposure to polychlorinated biphenyls (PCBs) used in building materials. This involved a review of plans, specifications and architectural drawings to identify likely areas of use, developing a comprehensive sampling program to verify emission rates and incorporating this into an

exposure model that included various building dynamics parameters such as solar loading, seasonal effects, ventilation patterns, and building pressurization.

Managed a comprehensive testing and analysis program designed to evaluate emissions of radiation from various building materials, including granite and marble for a large national distributor. The work involved developing testing protocols, measuring alpha and gamma emissions from the products under both controlled and real world conditions, and developing exposure estimates for various usage scenarios.

Developed a series of validation tests for fume hood orientations for a large medical research facility. This work involved building a mock-up of the research pod in a controlled test chamber and measuring emissions of a variety of possible contaminants from various operations and procedures that were performed in the containment. These systems were evaluated for various configurations, air exchange rates, and diffuser velocities.

Managed the assessment of emissions of sucrose residue from building materials in an historic structure that was being rehabilitated to a biotechnology research center. This work involved establishing test protocols to evaluate impact environmental conditions such as heat, pH, and moisture. Independent test cells were established at the facility and tests performed in situ.

Managed a program to determine the source of significant noxious odors in a twenty-eight story office tower. By establishing a series of isolated test cells within the building, the odor was isolated to butyric acid residue found in acoustical ceiling tiles located in various areas throughout the building. Additional chamber testing determined the environmental conditions under which butyric acid residue would be released. This data was then used to set allowable limits for acceptable performance during the manufacturing process.

Directed a study for a major hotel chain to evaluate emission of various organic compounds from water that was being processed through a new filtration/aeration system. This work involved developing and implementing a multifactorial study design to evaluate potential emissions that could be released under various operating conditions and different chemical composition of the source water.

Indoor Environments

Led the expert team supporting the U.S. Army Criminal Investigation Division's investigation of potential environmental and building factors associated with 11 reported infant deaths in Army housing at Fort Bragg. A primary objective of the investigation was to evaluate the claim that the infant deaths were related to "Chinese Drywall" in the housing units. In addition, the investigation involved a multi-pathway assessment of potential indoor environmental contaminants including:

VOCs, aldehydes, fungi, pesticides, allergens, metals and water quality. Building factors evaluated included: mechanical systems, ventilation and building envelope performance.

Principal-in-charge of more than 2,500 indoor environmental quality assessments in large office buildings, industrial facilities, schools, hospitals, residences, and other locations.

Principal-in-charge for design and implementation of specialized IAQ and IEQ monitoring programs.

Community and building occupant/employee liaison in IEQ investigations, providing risk characterization and risk communication services.

Principal-in-charge of EH&E's study team for U.S. Environmental Protection Agency's (EPA) *Building Assessment Survey and Evaluation (BASE) Study*. Dr. McCarthy assisted EPA in developing the study design and protocols, and directed EH&E's study team in the investigation of 100 buildings over a five-year period.

Principal-in-charge of the EPA contract "Technical Support for Indoor Air Issues."

Principal-in-charge of the Centers for Disease Control and Prevention, National Institute of Occupational Safety and Health contract "Building Related Asthma in Office Buildings and Schools".

Liaison with and consultant to various local, state, and federal agencies.

Development and implementation of health and safety programs in hazardous industrial settings. Assembly and management of rapid response teams charged with the assessment of potentially toxic conditions on a variety of sites ranging from transformer fires to areas contaminated with polynuclear aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), and heavy metals, including the mapping of areas of contamination onsite and development of site monitoring programs for the remediation phase and perimeter monitoring programs at hazardous waste sites.

Development of protocols for air, soil, and surface sampling for toxic compounds.

Developed and taught IAQ professional development training programs for building owners, managers, industrial hygienists, and engineers. This work has included a training program for NASA, several *Fortune 500* companies, and a complete revision of EPA's "Orientation to Indoor Air Quality," which is presented nationwide.

Led the hazard characterization and remediation program for the disaster recovery of a major laboratory/vivarium complex that had experienced a fire. This involved detailed contamination mapping of soot and metals throughout the 400,000 square feet impacted by the fire. This data was then used to characterize risk and develop cleanup criteria.

Infectious Agents

For a major teaching hospital, led the analysis of infectious risk potential for the first OR in the U.S. to provide interventional radiologists and surgeons with immediate access to a full array of advanced imaging modalities for use during multiple procedures. The traditional placement of supply air diffusers was not feasible due to the design of the clinical equipment being installed. By using advanced computational fluid dynamic (CFD) modeling, Dr. McCarthy evaluated multiple HVAC configurations and airflow patterns for critical infection control and optimal thermal comfort. The results identified a diffuser array in a non-traditional configuration would be equally effective in preventing particles (skin cells) from impacting the surgical site when compared to conventional systems. This approach not only was subject to peer review by surgical and mechanical design teams, it also had to pass regulatory approval from the Department of Public Health, which it did successfully, before licensing.

For a large urban teaching hospital, developed an evidence based design guide for new orthopedic operating rooms based on control of airborne infectious agents. This involved evaluating the international scientific literature regarding infections from airborne particles, critically reviewing current design guides and their underlying rationale, developing a reproducible test procedure that can be used to characterize the control of potentially infectious particles, and using the testing protocol to compare the effectiveness of the various designs located at multiple institutions.

Established and led an interdisciplinary team for a major teaching hospital that was charged with reducing inadvertent exposure to environmental opportunistic pathogens (e.g., *Aspergillus, sp.* and *Legionella, sp.*) and airborne pathogens (e.g., mycobacterium tuberculosis and varicella-zoster virus). This team identified surveillance techniques, response actions, design for physical isolation of infectious individuals and developed a policy that has been successfully implemented in this 1200 bed facility.

For a major cancer treatment center, developed a method of commissioning and verifying performance of building systems and isolation facilities for state of the art bone marrow transplant facility utilizing evidence-based design and implementation of comprehensive testing procedures. After performing a design review, comprehensive testing of sub-components such as HEPA filters, evaluation of means to optimize airflow within the suites, and ensuring appropriate pressure relationships within various areas of the facility was completed and documented.

Dr. McCarthy has been the Principal in Charge of more than twenty environmental investigations regarding assessment of infections related to *Legionella* bacteria. This work has involved reviewing epidemiological data, investigating and sampling potential sources, and overseeing implementation of corrective activities. This has taken place in environments as diverse as hospitals and hotels to retail establishments.

SELECTED PUBLICATIONS

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Brown KW, Minegishi T, Allen JG, **McCarthy JF**, Spengler JD, MacIntosh DL. 2014. Reducing patients' exposures to asthma and allergy triggers in their homes: an evaluation of effectiveness of grades of forced air ventilation filters. *Journal of Asthma*, 51(6):585-594.

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